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BLACKLEG

WITH NEW METHODS FOR ITS PREVENTION AND TREATMENT

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Blackleg is one of the common and probably the best known of any of the infectious diseases of cattle. Most cattlemen of any experience under range conditions have come in contact with the disease. It is prevalent throughout the western range country of the United States and is quite generally distributed throughout the world. Few, if any. live stock counties in California are entirely free from it. Some have claimed such freedom for years, only to find on careful investigation that animals, supposed to be dying from other causes, were in reality infected with this disease. It is the common cause of sudden deaths in bovine animals between six months and two years of age, and when such animals are dying it should be the first disease to be considered in ascertaining the cause. While it is more prevalent on the ranges, young cattle on dairy pastures in some sections of this state have to be regularly vaccinated to prevent losses.

CAUSE AND METHOD OF INFECTION

The cause of the disease is a rod-shaped micro-organism known as the Bacillus of Blackleg. This organism is strictly anaerobic, meaning that it will not multiply in the presence of the oxygen of the air. When it meets with unfavorable conditions, it forms spores which are the resting stage of the bacteria and are very resistant to adverse conditions. It is the spores which infect the soil, where they will remain alive for years. When they infect a susceptible animal, they must gain entrance through a comparatively slight wound of a penetrating nature which does not tear open the skin or mucous membrane and allow oxygen of the air to come in contact with the underlying tissue. Such injuries to the skin may be made by briers, sharp sticks, barbed wire, etc., through which wounds the bacteria enter. The disease is practically confined to cattle, although very rarely sheep, goats, and even hogs have been known to contract it.

Seasons have a marked influence on the disease. It is most liable to make its appearance in the late summer and fall, following which it is most prevalent in the spring, but it has been found in California at all times of the year.

SYMPTOMS

In many cases the first evidence of the disease is the finding of one or more dead animals with a local swelling under the skin. The time between which the organism gains access to the body and the first symptoms appear, known as the period of incubation, is from one to three days. The symptoms are both local and general. There is a marked rise of temperature, with loss of appetite and dullness, and the animal fails to keep up with the herd. This is accompanied with or soon followed by a characteristic local swelling on some part of the body. The swelling appears suddenly and contains gas formed by the bacteria which gives it a peculiar crackling feeling. It varies in size in different cases often beginning as a small area and spreading rapidly in extent until the animal dies. It never occurs below the knees or hocks but, with these exceptions, may be found in any part of the body. The frequent appearance of the swelling on one of the legs has given the disease its name of blackleg or black quarter. The quarter on which the swelling occurs is usually stiff and the animal goes lame. On incising the area the animal evinces little or no pain, and a dark-colored fluid is exuded, consisting of blood and broken-down muscle tissue mixed with gas bubbles having a sweetish-sour odor and frothy appearance. The area should be incised with caution as the discharges resulting are teeming with organisms and if allowed to drop on the ground will add further infection to the soil. Atypical cases of blackleg occur with no local swelling. The absence of swelling, therefore, is not alone sufficient evidence to exclude the disease—but in the vast majority of cases, careful examination will reveal a local affected area. So, also, while the age incidence is clearly marked, cases frequently occur up to three years of age and at times even in much older animals. The symptoms develop rapidly, accompanied by great weakness and depression, rapid breathing, and occasionally convulsions and death in from twenty-four to seventy-two hours.

POST-MORTEM APPEARANCE

The important things to observe in an animal dead of suspected blackleg are its age, the local swelling, and the practically normal spleen. On examining the carcass, the first step is to examine for the local swelling above described. On removing the skin over the area, a large, dark swelling involving the muscle will be observed. The muscle affection may be present in any degree from slight darkening of the normal muscle tissue with gas bubbles in its substance, to complete degeneration of the muscle in the center of the area to a semi-solid mass filled with gas bubbles. The peculiar, somewhat characteristic odor of the disease can be best obtained from the local swelling. Internally, there is a general congested condition of the organs as is seen in most all acute infectious diseases. The spleen, however, is not enlarged. The liver is congested and may show a mottled coloration on its surface. There may be present ecchymoses or small

hemorrhagic spots in the serous membranes, such as the pericardium or heart sack, pleura or lining of the chest wall and covering of the lungs and peritoneum, or covering of the intestine and lining the abdominal walls. The lungs are congested but show nothing characteristic.

Biological preparations used in prevention and treatment of blackleg.

In making post-mortem examinations of carcasses, care must be taken not to infect the soil further. Therefore, the work is to be done at the point of disposal of the animal. The carcass should be burned or buried deeply after covering with quicklime and the contaminated surface soil thrown on the fire or into the burial hole.

DIFFERENTIAL DIAGNOSIS

There are other diseases with which blackleg may be confounded, chief of which is anthrax. The latter is differentiated from blackleg by the fact that it attacks animals of all ages with equal frequency, as well as all species of domestic animals and man. In some cases a local swelling is present, but this is evidence of localization and is always slower in development. Animals with this form of anthrax will live longer than blackleg cases. On palpation of the local anthrax swelling, no crackling sound is noticed and, on cutting into same, no gas bubbles are present and the blackleg odor is absent. On post-mortem the spleen is found much enlarged and softened and the blood is black and tarry, clotting imperfectly or not at all. On account of the danger of further soil infection in opening anthrax carcasses as well as of human infection, it is better to have veterinary or laboratory assistance in making a diagnosis. (See circular from this station on anthrax, by Haring).

The laboratory diagnosis of blackleg from specimens received is unsatisfactory, as a rule, due in many instances to the character of the tissues sent and to more or less decomposition which usually occurs during transit. Under these conditions the isolation of the causative organism, which is difficult at best, is rendered almost impossible. Greater dependence should therefore be placed on the field examination, which is usually sufficient to make a positive diagnosis.

Another disease, quite common in California, which so closely simulates hemorrhagic septicaemia that it cannot be positively differentiated from it, may be mistaken for blackleg. This disease, however, affects animals of all ages. Local swellings are not usually present and on post-mortem examination extensive hemorrhagic blotches and small blood spots are present on the lining and covering membranes of the body cavities and organs.

TREATMENT AND PREVENTION

Powdered, Pellet, and String Vaccine.—Until recently no remedy of any real value was known and even now nearly all affected animals die. The method therefore has been to prevent the spread of the disease by vaccinating all susceptible animals as soon as the disease was found or in a great many cases to make vaccination the procedure on all infected lands without waiting for the disease to make its appearance. This vaccine was made by drying the affected muscle tissue from animals dead of blackleg. It was then ground in a mill,

moistened, spread out on thin trays and subjected to heat at about 95° C. for six hours, which weakens or attenuates the organisms. When the resulting material containing the powdered muscle tissue and spores is injected into an animal, it produces a mild form of the disease which renders the animal immune from natural infection. As originally made by Arloing, who devised the method, two vaccines were used, the first being subjected to a higher degree of attenuation than the second. No. 1 vaccine was used to prepare the animal to be immunized for the second stronger vaccine given ten days to two weeks later. As generally used at present, only one injection is given. After heating and regrinding the vaccine is always tested on guinea pigs to see that the contained organisms have been properly attenuated by the heat before sending it out.

This vaccine in powdered form has been put out by the U. S. Bureau of Animal Industry free of charge to cattlemen for twenty years, at the rate of from one to several million doses yearly. Commercial biological firms have been making the same vaccine in pellet as well as string form, which is easier to administer, and are selling it in large quantities as a preventive of the disease. Many stockmen have used this vaccine and statistics covering millions of animals so treated as a whole show most satisfactory results.

The fact remained, however, that the vaccine could not be properly standardized. Its activity depended on the presence of spores of the blackleg organism. To give proper immunity it was necessary for these spores to germinate in the body of the injected animal. There was no way of ascertaining the number of these spores and one vaccine might contain few while another would contain many. In spite of the guinea-pig test batches of vaccine have been sent out which were not sufficiently attenuated by the heating process, and resulted in the production of the disease in the less resistant of the injected animals and in some very severe losses. At other times sufficient spores would not be present or they had been too highly attenuated by heat, so that no immunity was produced and injected animals would continue to die from natural infection. Also the vaccine had no curative effect and some time was required after injection before immunity was established, during which time losses from natural infection would continue. It was these facts so well known to all workers with blackleg vaccine, both in the laboratory and in the field, that led to the development of what may be called the new methods of treating and preventing this disease.

Blackleg Serum.—In the treatment of this disease there is now being produced a blackleg serum, originated in Europe by Kitt, Vallee, Leclainche and others. This is prepared in the usual way of making serum for other infectious diseases. Horses or cattle are gradually infected with blackleg organisms of increasing virulence and numbers until they can withstand enormous doses of the most virulent strain of the organisms injected directly into the circulating blood. These animals are then bled from the jugular vein under aseptic precautions and the serum allowed to separate from the

clotted blood. This serum contains immune bodies against the blackleg organism and when injected into an affected animal in sufficient doses has distinct curative properties. In smaller doses it will also protect healthy animals against the disease immediately. The effect produced by the injection of such a serum is termed passive immunity, as distinct from active immunity, which is produced by an attack of the disease or by causing the animal to pass through a mild form of the disease such as is caused by vaccination. Passive immunity in this disease is of short duration and cannot be depended on for a longer period than ten days. Unless a supply of serum is close at hand, blackleg-affected animals will be dead before they can be treated.

The great field of usefulness of the serum is in its application to all susceptible animals in a valuable herd where animals have already died, to produce an immediate immunity and cessation of further cases developing. For this purpose 25 to 30 cubic centimeters are given each animal with a hypodermic syringe under the skin. As a curative in animals already affected several injections may be necessary with much larger doses of from 100 to 200 cubic centimeters. In herds where serum is being administered it is well to take temperatures of the animals and any with a high temperature (104° F. or above) should be considered as infected with the disease even if showing no other physical signs. Such animals should be given 100 cubic centimeters or more of serum as a curative. After this has been done and the disease stopped, it must be followed in a week by a vaccination of the animals to produce an active immunity, which is much more lasting. The cost of such a procedure at the present time probably justifies its use only in suddenly appearing severe outbreaks and in valuable pure-bred animals. Commercial houses are charging from 3 to 4 cents per cubic centimeter for the serum, depending on the quantity purchased. The difficulty with the serum is that at the present time no definite means of standardizing it have been perfected and no degree of potency is required. If further field trials prove its value this will no doubt be given consideration.

Tissue Filtrate and Culture Filtrate.—In the prevention of the disease two new products are now being prepared. These are both free from the causative organism in either vegetative or spore form and therefore cannot produce the disease. One of these is made directly from the muscle juices of affected animals, which are extracted by pressure, and is known as tissue filtrate, and the other is made by growing the blackleg organism under anaerobic condition in the laboratory in a special medium containing meat, and the product is known as culture filtrate. The term filtrate is applied because the finished products are filtered through specially constructed clay filters of such fine porosity that no bacteria are allowed to pass. The tissue filtrate or extract is also called aggressin in the literature put out by the commercial laboratories which have the products for sale.

The tissue filtrate or aggressin was developed by veterinarians at the Kansas Agricultural College, and the culture filtrate, by Nitta, of the University of Tokio, in Japan. The first product requires the

actual production of the disease in animals to obtain the affected muscle tissue and juices. A great amount of the material cannot be obtained from one animal. It can be readily seen, therefore, that its production on a large scale would involve the sacrifice of a good many young cattle and its cost thereby be greatly enhanced over that of the culture filtrate. Even though experiments may prove the protective value of the tissue filtrate to be greater than that of the culture filtrate, this difference may not be sufficiently great to warrant the increased cost of the former. Further experimentation, backed up by field trials, is required on this point. In the final stages of manufacture the culture filtrate is partially evaporated to reduce its volume and preserved by the addition of glycerin. The present cost of the culture filtrate is from 15c to 20c per dose, depending on the quantity purchased. The material is put up to inject in 1 cubic centimeter or 5 cubic centimeter doses, depending on the degree of concentration. The tissue filtrate costs 30 to 35 cents per dose of 5 cubic centimeters. Both kinds of vaccine are in liquid form. The freedom of these products from the blackleg organism is greatly in their favor as this precludes the setting up of a virulent form of the disease through their use. A considerable number of laboratory experiments have clearly demonstrated that these products have distinct immunizing value and these have been backed up by many field trials on a considerable number of animals. In Japan the culture filtrate is the only means of immunization at present in general use. The product is tested in the laboratory on guinea pigs before it is ready for distribution. Further standardization would, however, be desirable, which would include toxicity tests.

Rather extravagant claims have been made for these products with the desire to get them into general use against the competition of the older and cheaper powdered muscle vaccine. Chief of these may be mentioned the claim that they will produce permanent immunity or at least immunity until the animal has passed the susceptible age with one injection. At the present time there does not seem to be sufficient evidence to justify such claims. Where these results have appeared to be obtained under field trials unusually favorable conditions may have prevailed. The degree of infection of ranges undoubtedly differs in this disease as it does in anthrax. Where animals have passed through the susceptible age period with one treatment they may have been on very slightly infected ranges. Also, animals treated as yearlings or older might pass through safely with one treatment, whereas animals treated at six months of age under the same conditions might break with the disease as short two-year-olds. Further evidence is necessary before any conclusive statements can be made on this subject. This station is very anxious to obtain such evidence and to make it available for stockmen. Any data along this line which are obtained, therefore, from the use of either blackleg serum or culture or tissue filtrate would be gratefully received and tabulated by this experiment station if sent to the Division of Veterinary Science, University of California, Berkeley.

WHEN TO VACCINATE

On known infected ranges cattle owners should not wait for the disease to appear before vaccinating susceptible animals. As there are two principal seasons for the disease there should be two vaccination periods, one in the spring and the other in the fall. The vaccination should be done fifteen to thirty days before the time when cases have usually appeared in the past. As a general practice, the period between February 15 and March 1 is a good time for the spring vaccination and from August 15 to September 1 for the fall vaccination. This may, of course, have to be varied depending on local conditions. Young animals being turned out on unknown ranges or pastures should be vaccinated as a precautionary measure. It is not necessary to vaccinate young animals on dairies or in small valley communities where no cases of the disease have been reported. One should not brand, castrate, or ear-mark and vaccinate at the same time. With our present knowledge it is safer to vaccinate all animals of susceptible age at each vaccination period. It may save the life of an animal at times, when the muscle vaccine is used, to give them the double vaccination. In this case No. 1 vaccine should be given ten days to two weeks before No. 2 vaccine.

SUMMARY

Blackleg is quite generally prevalent in California. Stock owners should suspect the disease in all cases where animals from six months to two years of age die suddenly with a local swelling.

The old single or double muscle vaccine for blackleg in either powdered, pellet, or string form, has given such satisfactory results for so many years that its continued use is justified.

Blackleg serum has immediate immunizing and curative properties. Its use is to be recommended in affected animals and in the hope of immediately stopping losses in already infected herds where animals are dying of the disease. Its immunizing effects in healthy animals are not permanent and it must be followed by vaccine or filtrate within a week to ten days.

Both culture filtrate and tissue filtrate have well-marked immunizing effects on cattle against blackleg. Their freedom from the causative organism is greatly in their favor.

The routine use of either of these preparations by cattlemen is justified under our present knowledge. In time, they may largely replace the old method of vaccination.

Culture filtrate of sufficient potency is of equal value and has advantages in manufacture and cost over tissue filtrate.

There are not sufficient data available to substantiate the general statement that one treatment with either of the filtrate vaccines will confer life immunity.